Electronic Version

Stylesheet Version v1.1.1

Claims

[c1] What is claimed is:

1.A method for reducing a blocking artifact in a video stream, the method comprising:

calculating an activity value representing local activity around a block boundary between a plurality of adjacent blocks in the video stream;

determining a region mode for the block boundary according to the activity value; and

selecting one of a plurality of at least three filters to filter a plurality of pixels around the block boundary to reduce the blocking artifact according to the region mode.

[c2] 2.The method of claim 1, wherein calculating the activity value comprises summing absolute differences between pixels V_i around the block boundary as follows:

$$ACTIVITY = \sum_{i=4}^{6} |v_i - v_{i+1}| + \sum_{i=8}^{10} |v_i - v_{i+1}|$$

[c3] 3.The method of claim 1, wherein:

if at least one of the adjacent blocks is an intra-coded block:

if the activity value is greater than a first threshold, determining the region mode to be an active region;
if the activity value is less than the first threshold but greater than a second threshold, determining the region mode to be a smooth region; and
if the activity value is less than the second threshold, determining the region mode to be a dormant region; and
if none of the adjacent blocks are intra-coded blocks:
if the activity value is greater than a third threshold, determining the region mode to be an active region;
if the activity value is less than the third threshold but greater than the second threshold, determining the region mode to be a smooth region; and
if the activity value is less than the second threshold, determining the region mode to be a dormant region.

[c4] 4.The method of claim 3, wherein the second threshold is fixed at a predetermined value.

[c5] 5.The method of claim 4, wherein the predetermined value is 6.

[c6] 6.The method of claim 3, further comprising:
if at least one of the adjacent blocks is an intra-coded block:
if the region mode is active region,
if a high frequency component c_3 is less than a fourth

threshold, filtering the pixels around the block boundary using a first filter;

if the region mode is smooth region,

if the absolute value of the difference of the pixel values on either side of the block boundary is less than a fifth threshold, filtering the pixels around the block boundary using a second filter; and

if the region mode is dormant region,

if the absolute value of the difference of the pixel values on either side of the block boundary is less than the fifth threshold, filtering the pixels around the block boundary using a third filter; and

if none of the adjacent blocks are intra-coded blocks:

if the region mode is active region,

if the high frequency component c_3 is less than a sixth threshold, filtering the pixels around the block boundary according to the filtering range using the first filter;

if the region mode is smooth region,

if the absolute value of the difference of the pixel values on either side of the block boundary is less than a seventh threshold, filtering the pixels around the block boundary according to the filtering range using the second filter; and

if the region mode is dormant region,

if the absolute value of the difference of the pixel values on either side of the block boundary is less than a sev-

enth threshold, filtering the pixels around the block boundary according to the filtering range using the third filter.

[c7] 7.The method of claim 6, further comprising adaptively determining the first, third, fourth, fifth, sixth, and seventh thresholds by at least taking into account differences in quantization parameters QPs of the adjacent blocks.

[c8] 8.The method of claim 7, further taking into account a user defined offset (UDO) allowing the first, third, fourth, and fifth threshold levels to be adjusted according to the UDO value.

[c9] 9.The method of claim 6, wherein the high frequency component (c_3) is calculated using pixels v_6, v_7, v_8, v_9 around the block boundary as follows:
$c_3 = (v_6 - v_7 + v_8 - v_9)/2$.

[c10] 10. The method of claim 6, wherein the first filter is a one dimensional filter formed by using a 4-point Hadamard Transform (HT), wherein the high frequency coefficient of the HT is reduced to 0 for frame-coded pictures.

[c11] 11. The method of claim 6, wherein the first filter is a one dimensional filter formed by using a 4-point

Hadamard Transform (HT), wherein the high frequency coefficient of the HT is reduced to one half for field-coded pictures.

[c12] 12.The method of claim 6, wherein the filtered pixels are further refined by adjusting a pixel quantized with a larger QP to have more change in value than a pixel quantized with a smaller QP.

[c13] 13.The method of claim 12, wherein a first weighting value WT1 and a second weighting value WT2 are used for adjusting the filtered pixels and are obtained from a first quantization parameter QP1 of a first adjacent block and a second quantization parameter QP2 of a second adjacent block as follows:

$$WT1 = QP1 / QP1 + QP2 \ , \quad WT2 = QP2 / QP1 + QP2$$

[c14] 14.The method of claim 6, wherein if the quantization parameters (QPs) of the adjacent blocks are the same, symmetric second and third filters are used to filter the pixels around the block boundary for smooth and dormant region modes, respectively; and
if the QPs of the adjacent blocks are not the same, asymmetric second and third filters are used to filter the pixels around the block boundary for smooth and dor-

mant region modes, respectively.

[c15] 15.The method of claim 14, further comprising

when the region mode is smooth region and the QPs of the adjacent blocks are the same, filtering the pixels around the block boundary with an N-tap symmetric second filter;

when the region mode is smooth region and the QPs of the adjacent blocks are not the same, filtering the pixels around the block boundary with an M-tap asymmetric second filter;

when the region mode is dormant region and the QPs of the adjacent blocks are the same, filtering the pixels around the block boundary with a K-tap symmetric filter third filter; and

when the region mode is dormant region and the QPs of the adjacent blocks are not the same, filtering the pixels around the block boundary with an L-tap asymmetric third filter.

[c16] 16.The method of claim 15, wherein:

N = 5 and the symmetric second filter is [1 3 8 3 1]/16;

M = 5 and the asymmetric filter is [1 2 8 3 2]/16 and [2 3 8 2 1]/16;

K = 5 and the symmetric filter is [1 2 2 2 1]/8; and

L = 5 and the asymmetric filter is [1 1 2 2 2]/8 and [2 2 2 1 1]/8.

[c17] 17.The method of claim 6, wherein filtering the pixels around the block boundary comprises first filtering the pixels at the block boundary and next filtering pixels not adjacent to the pixels at the block boundary.

[c18] 18.The method of claim 1, further comprising if the video stream comprises interlaced video, performing an interpolation operation to estimate pixel values in an interlaced field before filtering the pixels around the block boundary.

[c19] 19.The method of claim 1, further comprising determining a filtering range according to block coding types of the adjacent blocks in the video stream; wherein the filtering range specifies a number of pixels to filter around the block boundary.

[c20] 20.The method of claim 19, wherein according to the block coding types of the adjacent blocks in the video stream, determining the filtering range to be up to eight pixels around the block boundary.

[c21] 21.The method of claim 19, wherein determining the filtering range according to the block coding types of the adjacent blocks in the video stream further comprises: if at least one of the adjacent blocks is an intra-coded block, determining the filtering range to be up to four

pixels around the block boundary; and

if none of the adjacent blocks are intra-coded blocks, determining the filtering range to be up to eight pixels around the block boundary.

[c22] 22.The method of claim 1, wherein the video stream is an MPEG video stream.